INTERIM TEST AND EVALUATION REPORT

25X1

[redacted]

MODEL B, HIGH INTENSITY LIGHT TABLE

June 1969

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Test & Evaluation Branch
ESD/TSSG/NPIC

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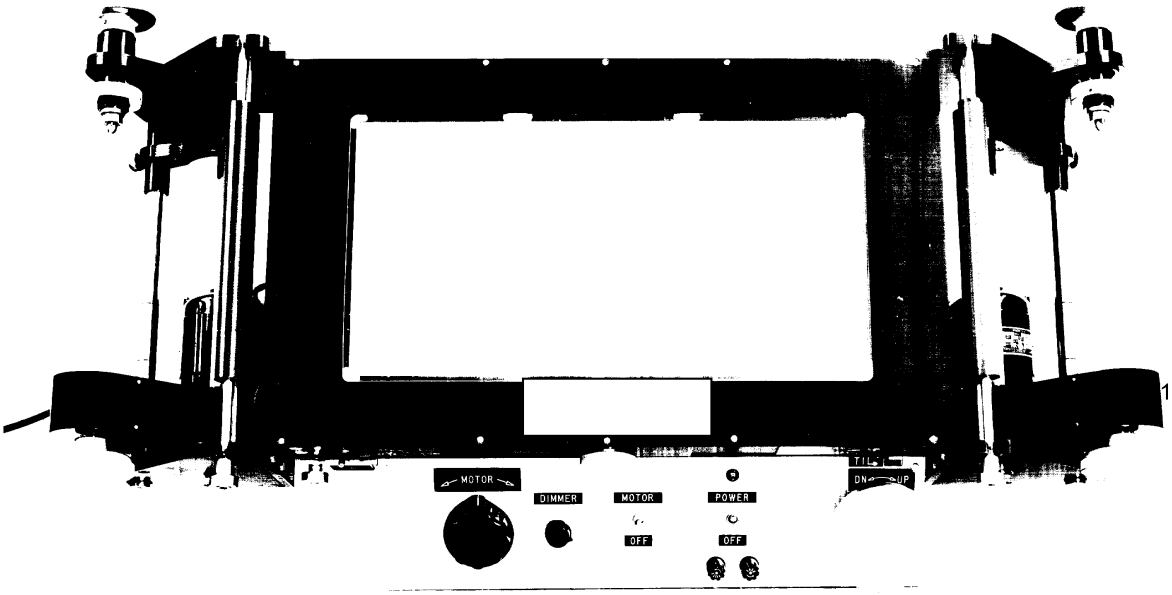

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1. INTRODUCTION

25X1 The [redacted] Model B High Intensity Light Table was developed and fabricated by [redacted] without 25X1 any known government funding. The Center provided its design require-

25X1 ments to [redacted] for a viewing light table in the form of a document entitled "Design Objectives for the Advance Light Table Prototype." This document was also used for the second phase contract development (production prototype) of a 918 Light Table by [redacted] 25X1

25X1 [redacted]

Prior to contract award for the [redacted] 918 Advance Light 25X1 Table Prototype, a quick response test and evaluation of the first [redacted] 25X1

25X1 [redacted] Light Table was accomplished by ESD/TEB. T&E Report No. 68-11, dated May 1968 stated test results and recommended changes for product improvement. The equipment was also evaluated by one of NPIC's operating components.

The manufacturer re-designed the table incorporating improvements suggested by NPIC plus some of their own. The table, now called the [redacted] 25X1

25X1 [redacted] Model B High Intensity Light Table was received on loan in early May for test and evaluation. Tests conducted on the [redacted] Advance 25X1 Light Table Prototype at that time delayed the initiation of the test and evaluation of the new manufacturer's sample until 26 May.

The parallel development of similar viewing light tables, one funded by government, to other by industry, gives cause for making comparisons

between the two tables with respect to the Center's needs as outlined in the design objective. For this reason the same test and evaluation format was used for both tables.

In designing their table, [redacted] has made an attempt to conform with most of the Center's design requirements, however, they were not held to any contract restraints or requirements such as was the case with [redacted]

25X1

25X1

2. SUMMARY OF TEST RESULTS

TEST ITEM	TEST RESULTS
2.1 GENERAL REQUIREMENT	
2.1.1 Concept	The [redacted] Light Table is simple in mechanical design providing for easy loading of film on flange spools and a simple film transport system. It accomodates single rolls of film between 70mm and 9 1/2 inches in width. The table has a manual tilt mechanism for tilting the viewing surface along its short or long axis. The film transport system has two modes of operation; a bi-directional power drive capable of slow or fast film transport and manual for transporting short lengths of film by rotating knurled wheels on either of the spool brackets. The table does not have handcranks. It is not light weight and could probably be made more compact along its long dimension. 25X1
2.1.2 General Description	
2.1.2.1 Basic Characteristics	The [redacted] table is less compact and slightly heavier than the [redacted] Advance 918 Light Table but less complex in mechanical and electronic design. Cost of the [redacted] table is unknown. 25X1 25X1 25X1 25X1
2.1.2.2 Film Transport and Tilting Systems	The basic film transport system consists of two 1/60 HP drive motors, one on each fixed film bracket. Film tension is applied while the film is stationary or being transported in either direction in the manual or power driven mode of operation. The mechanism used to tilt the table consists of a 4 inch hand crank, driving a low friction ball-screw which raises a single elevating post attached to the underside of the light box.

TEST ITEM	TEST RESULTS
2.1.2.3 Illumination System	Illumination system consists of a grid with a Haleon 3500 series light tube. Dimming control is excellent.
2.2 ILLUMINATION SYSTEM	
2.2.1 Size of illuminated area	Illuminated area is 9 1/2 by 18 1/2 inches.
2.2.2 Level of illumination	Illumination was measured in 24 equally spaced areas over the entire illuminated surface at three operating voltages. Measurements were also made in 18 equally spaced areas at 117 volts disregarding illumination in areas within one inch of the viewing glass perimeter.

At full intensity	Operating Voltage		
	102V	117V	127V
Max. Value	2060fl	2220fl	2320fl
Min. Value	1310	1460	1530
Average Value	1800	1950	2070

(When measuring the center 7 1/2 by 16 1/2 inch area)

	117V
Max. Value	2260fl
Min. Value	1810
Average Value	2100

2.2.3 Uniformity

Light Variation	Operating Voltage		
	102V	117V	127V
Between Min. & Max. Values	36.5%	34.2%	34.0%
Max. Variation from Average Illumination	27.2%	25.2%	26.1%

(When measuring the center 7 1/2 by 16 1/2 inch area)

	117V
Between Min. & Max. Values	20%
Max. Variation from Average	13.8%

TEST ITEM	TEST RESULTS
2.2.4 Controllability	Illumination continuously variable throughout a range of from 7% (175fl.) to 100% of full intensity without evidence of flicker. Very slight flicker was evident when dimmed to 135 fl. Readings were made at 117 volts.
2.2.5 Reliability	The table light was operated for an estimated 30 hours during the test and evaluation period. There was no change in brightness values during that time.
2.2.6 Diffuser	A 1/8" milk white synthetic resin plastic diffused is located between the glass top and the light source.
2.2.7 Shade	A white spring loaded adjustable curtain shade is provided. The shade adjusts to detented positions by turning a 2 inch diameter knurl control knob located on the center front surface of the viewer. Detent stop locations are different when the knob is rotated clockwise than when rotated counterclockwise.
2.2.7.1 Location	The shade is located between the top surface glass and the diffuser. It is mounted along the long dimension of the unit and extendable across the short dimension toward the side with the fixed film spool holders.
2.2.7.2 Positioning Capability	The shade will extend completely across the illuminated surface but only locks in certain positions where a spring loaded ball bolt engages into detents. By rotating the shade control knob clockwise, the shade locks into detents giving the following unmasked illuminated depths: 9 1/16, 6 13/16, 5 3/4, 5, 2 3/4, 1 3/4 or 1 inch. By rotating the knob counterclockwise, the following unmasked illuminated depths are obtained: 8 13/16, 6 5/8, 5 13/16, 4 13/16, 2 9/16, 1 3/4 inches or completely closed. All measurements were made from the front edge of the illuminated surface which aligns with the one edge of

TEST ITEM	TEST RESULTS
2.2.7.2 Positioning Capability (Cont'd)	the film once the table is threaded for film transport. The shade can be placed in most any position and it will remain for a period if at first the shade is closed beyond the desired position and then opened slowly. This is because the shade retractor spring force is not sufficient to overcome the frictional force of the detent bolt against the detent wheel in all cases.
2.2.7.3 Encroachment	The shade will not encroach upon the illuminated viewing area when completely retracted. The shade does rub along the top surface of the diffuser when it is being adjusted causing linear abrasions on the top surface of the diffuser.
2.3 FILM TRANSPORT SYSTEM	
2.3.1 General Requirements	
2.3.1.1 Modes of Operation	At the operator's option, either full power drive or direct 1:1 ratio manual drive are available. The bi-directional motor drive transports the film to the right (when viewing the table along its long width) by rotating the motor control knob clockwise and to the left when counterclockwise. Three inch diameter knurled wheels are connected to the end of each spool spindle shaft which when turned by hand transports the film by a 1:1 direct rotational drive ratio. These wheels would normally be used for transporting short lengths of film, however, entire rolls of film can be manually transported with reasonable effort.
2.3.1.2 Film Capacity	The film transport system will accommodate single rolls of film between 70mm and 9 1/2 inches in width on either partially or fully loaded reels up to 500 foot capacity. The manufacturer has stated that future tables will be configured to accommodate 10 1/2 inch flange diameter, 1000 ft. capacity spools. Future tables will be about 2 inches longer not including spools.

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TEST ITEM	TEST RESULTS
2.3.1.3 Film Tension	Two motors, one attached to each fixed film bracket assembly, apply approximately 1/2 pound tension to the film when it is stationary. (Motor control knob has a null position when positioned in its most upright setting.) Film can be manually or motor transported in either direction and tension is maintained. A slight bit more tension might be advantageous. When 9 1/2 inch film is stationary and on the table emulsion side up, film curl causes the center portion of the film to touch the glass surface. This appears to correct itself when the film is power transported. To prevent overriding the tension system when manually transporting film, the spindle wheel on the end of the table corresponding to the take-up spool should be the one hand rotated.
2.3.1.4 Spool Rotation	Switches are provided on the left and right sides of the table's front upper assembly for reversing the direction of each film spool independently.
2.3.1.5 Tracking-Detrimental Effects	Tests were conducted, transporting film by motor drive and manually, with film emulsion side up and with it towards the illuminated surface. There was no evidence of scratches on the film surface due to it hitting the roller or glass surfaces or because of film cinching on the spools. Film edges did rub against the spool flanges during take up, especially with ultra thin base 6.5 inch wide film used as one of the test conditions. No damage was done to the film, however, this condition adds to the noise level of the relatively quiet transport system and becomes more evident because of the fast film transport speed available with this table. Slight misalignment between the spool spindles and transport rollers could cause this condition. Alignment adjustments for skew are not provided on the table therefore corrections for this condition could not be attempted.

TEST ITEM	TEST RESULTS
2.3.1.6 Film Rollers - Choice of Materials	Manufacturer states that film rollers are polished and hard anodized with a heavy coating of aluminum oxide which is much harder than steel.
2.3.1.7 Tension Adjustment	There are no tension adjustments to make. The transport system maintains relatively low film tensions for all spool diameter ratios and film widths.
2.3.2 Manual Drive Mode	
2.3.2.1 Film Movement and Control	Manual film drive is accomplished by placing the motor drive in the null position and by turning either of four knurled spool spindle handwheels. The normal operation is to rotate either of the two wheels which are nearest to the film take-up spool. This provides any transport speed the operator desires without causing film loops, within the physical limitations of manually rotating the wheel. For slow transport speeds, the wheels on the opposite end from the take-up spool can be rotated, and the normal motor tensioning torque will spool the film. The spool spindle handwheels are common to both the manual and power driven transport systems. For this reason manual assist power drive is possible for slow transport speeds. This is useful for momentary speed increases with slow film scanning operations.
2.3.2.2 Drive Ratio	The manual drive has a 1:1 ratio between the handwheels and the spools.
2.3.2.3 Ease of Operation	The drive system provides very smooth and easy winding and unwinding of short lengths of film from either spool. Although it is possible to manually transport long lengths, it is not practical or necessary because of the power transport system.

TEST ITEM	TEST RESULTS
2.3.2.4 Inertia Damping and Anti-Backlash Control	Torque provided by motor is sufficient for inertia damping and anti-backlash control.
2.3.3 Power Drive Mode	
2.3.3.1 Transport Speed	A 500 foot spool of 9 1/2 inch wide film can be transported across the table in 75 seconds.
2.3.3.2 Speed Control	Variable speed control allows slow scanning as low as 3 inches per second without excessive jumping. When full speed transport is called upon, film transport reaches 8 1/3 ft./sec. (500 ft./min.) or be as low as 3 1/3 ft./sec. (200 ft./min.) depending on ratio of film on supply and take up spools. This data represents average speeds over 5 ft. film spans and is based on transport tests conducted with a 450 foot length of 9 1/2 inch film. The speed control knob has a definite but not detented null position which is located by positioning the knob index and pointer to its most upright position. The null position can also be located by sound (under low noise conditions) since it is located between two switch contacts. A detented position for the null position is desirable.
2.3.3.3 Control Sensitivity	The power drive control is excellent and has high sensitivity over the entire range.
2.3.3.4 Inertia Damping and Anti-Backlash Control	Sufficient motor torque is supplied in all cases for inertia damping and anti-backlash control of spools. Film does not backwhip when reversing direction of travel.
2.3.4 Film Spool Loading and Holding Mechanism	
2.3.4.1 Spool Brackets and Spindles	A pair of spool brackets, one fixed and one movable, is provided on each end of the table. A quick-release spindle is provided

TEST ITEM	TEST RESULTS
2.3.4.1 Spool Brackets and Spindles (Cont'd)	on each movable spool bracket. These can be locked in a protracted position by rotating a knurl locking collar. This feature is somewhat helpful when mounting film spools on the table but does not help in removing the spools since the position of the locking collar precludes its use without difficulty. (One hand is needed to hold the film spool, one for holding the spindle handwheel and a third hand for rotating the lock collar.) Approximately 10 lbs. force is required to open the spindle for removing film spools. This spring action seems to be more than necessary for holding the spindle in the end of the film spool during operation. Less spring action would be sufficient to prevent accidental spool dumping and would allow easier removal when required.
2.3.4.2 Bracket Location	The fixed brackets are located on the side of the table which the operator normally faces when he is adjacent to the long axis of the table.
2.3.4.3 Bracket Adjustment	The movable brackets allow for various spool widths to handle 70mm to 9 1/2 inch film. After positioning, the brackets are locked in place with a thumb screw. Positioning marks for 70mm and 5 inch film spools are located on the assembly slide rods. The movable bracket when fully extended is the correct width for 9 1/2 inch spools, however, a very slight increase in width would make it easier to load this size spool.
2.3.4.4 Film Capacity	The spool handling mechanism firmly supports a full, 500 foot spool of 9 1/2 inch film or narrower at any table position in any operation.
2.4 TILT MECHANISM	

ITEM	DESCRIPTION
2.4.1 Amount and Direction of Tilt	The tilt mechanism permits the illuminated viewing assembly to tilt 76° above horizontal along its long axis and 75° above along its short axis.
2.4.2 Pivot Point	The fixed position pivot for tilt along the table's long axis is one inch back from the leading edge of the light table base. Along its short axis it is three inches in front of the leading edge of the base. For maximum tilt about the short axis, the base must extend about 3/4 inch beyond the support table edge so the motor will clear the base assembly.
2.4.3 Operation	Tilt adjustments about both axes are made manually by a handcrank which drives a low friction ball screw mechanism to raise an elevating post attached to the viewer box. To tilt forward along the long axis, a knob near the upper left corner of the control panel must first be pulled and held until a few turns have been made with the tilt crank. About 8 pounds force is required to initially rotate the handcrank to tilt along the long axis and 12 pounds along the short axis. Since the viewing box is not mounted on a turn table, it is necessary to rotate the table base on the support table before tilting along the short axis. This then places the table controls on the right side of the base with respect to the operator.
2.4.4 Tilt Lock Mechanism	Tilt position is held by a gear reduction in all positions.
2.5 HUMAN FACTORS	
2.5.1 Location of Controls	
2.5.1.1 Main Power	The main controls of the table are on the long side of the table base which

TEST ITEM	TEST RESULTS
2.5.1.1 Main Power (Cont'd)	faces the operator for all operational modes except when the table it tilted along its short axis. For this condition, the main controls are positioned along the right side of the base.
2.5.1.2 Power Transport	The motor transport knob is slightly difficult to reach when the table is tilted about the short axis.
2.5.1.3 Speed-Range Selection	Not applicable for this evaluation.
2.5.1.4 Manual Film	Not applicable for this evaluation.
2.5.1.5 Illumination Intensity	The illumination intensity dimmer knob is located to the left of the base front center and is slightly difficult to reach when the table is tilted about its short axis.
2.5.1.6 Shade Positioning	The shade positioning control is located along the center of the front surface of the viewer box assembly. Its position allows ease of operation for all modes of operation.
2.5.1.7 Spool Reversing	Spool rotation reversing switches are located on the right and left sides of the front surface of the viewer assembly. No difficulties were encountered in their use.
2.5.1.8 Table Tilt	A 4 inch diameter handcrank for tilt control is provided on the right side of the table base.
2.5.1.9 Film Tension	There are no film tension adjustments to make with the table. Turning the motor power switch off releases the approximately 1/2 pound film tension.
2.5.2 Control Size and Shape	
2.5.2.1 Main Power	The main power control is a toggle switch. There are three other toggle

TEST ITEM	TEST RESULTS
2.5.2.1 Main Power (Cont'd)	switches on the table, the motor power toggle switch being located only 3 1/2 inches distant. Switch identity is by location and labeling, not by shape, size, color or built in illumination. A small red "power on" indicator light is above the main power switch.
2.5.2.2 Power Transport	The control knob is 2 1/2 inches in diameter and can be easily found by touch and gripped.
2.5.2.3 Manual Film Drive Handwheels	All handwheels are three inches diameter and are easily gripped.
2.5.2.4 Control Labeling	The motor power toggle switch and power transport speed control knob are given the same lable identity. The control knob should be identified by a label such as "Film Transport" for better identification.
2.5.4 Noise Level	
2.4.4.1 Stationary Viewing Mode	The table light source is virtually free of hum. When used for stationary viewing, the noise level (measured 2 feet from the table with a [redacted] Sound Level Meter) was not measureably higher than room ambient when measured on A, B, and C meter weighted scales. Room ambient noise level measurements were 40, 49, and 58 decibels.

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TEST ITEM	TEST RESULTS

2.5.4.2 Dynamic Operation Noise Level

DYNAMIC OPERATION NOISE - DECIBELS

Operation	*weighted scale A	B	C
Ambient Noise	40	48	61
Light-on and film transport to right (Power mode-max. speed)	66	68	70
Light-on and film transport to left (Power mode-max. speed)	67	67	69
Tilt operation - short axis (manual crank up)	50	53	64
Tilt operation - short axis (manual crank down)	51	54	61
Tilt operation - long axis (manual crank up)	51	52	61
Tilt operation - long axis (manual crank down)	54	55	62
Manual Transport (to the right or left)	58	61	64
Slow scan speed transport (Power mode)	52	55	61

*Note: All readings are best visual average meter indications with the General Radio Meter set for slow response sensitivity.

2.6 DIMENSIONS AND WEIGHT

2.6.1 Table Size

Table dimension when facing the long tilt axis

Width (no spools)	- 39 1/2 inches
Width (500 ft. spools)	-
Depth	- 18 1/4 "
Height, table viewing surface horizontal	- 10 1/2 "
Height, viewing surface, when horizontal	- 9 "
Height at maximum tilt angle	- 22 "
Base width	- 20 1/4 "
Base depth	- 15 "
Maximum overhang, table tilted	- 5 "

TEST ITEM	TEST RESULTS
2.6.1 Table Size (Cont'd)	Table dimensions when facing the short tilt axis
	Width — 18 1/4 inches
	Depth, when table horizontal — 39 1/2 "
	Depth, at maximum tilt angle — 29 3/4 "
	Height, at maximum tilt angle
	- above base support — 36 "
	- below base support — 3 1/4 "
	Base width — 15 "
	Base depth — 20 1/4 "
	Maximum overhang, table tilted — - 10 "
2.6.2 Table Weight	Table weight - 138 lbs.
2.6.3 Portability	Weight and size do not permit one man to move the table unassisted. Carrying handles or lift bars are not provided. Because of the tilt mechanism, the table must be picked up by the base assembly only.
2.7 ELECTRICAL REQUIREMENTS	
2.7.1 Power	The table operates in all modes of operation on 117V + 10V-15V, 60 cycle AC. Maximum power requirements (amperes):

	102V	117V	127V
Light Source	4.4	3.9	5
Film Transport	0.6	0.6	0.8
Light and Transport	4.8	4.1	5.3

2.7.2 Fusing	Two Littlefuse No. 312, 3 AG, 6 amp, 250 volt fuses protect the circuitry.
2.7.3 Wiring Location	All electric wires between base and viewer assemblies are encased in a wire protector.

TEST ITEM	TEST RESULTS
2.8 SAFETY ENGINEERING	
2.8.1 Electrical Shock Hazard	Unit is grounded, however, an electrical potential exists between metal surfaces of the table and any ground if the normal ground system is bypassed as when connecting the power cord to a two wire power service receptacle using an adapter connector. This electrical leakage may be sufficient to give a shock to any operator who touches the table and any conductor leading to the ground at the same time. This leakage should be corrected. Do not bypass the ground terminal by using an adapter connector on a two wire electrical system without first establishing a new earth ground connection.
2.8.2 Shielding	All gears and other moving parts with the exception of the film spools, film spool spindles and controls are sufficiently shielded to prevent possible accidents during operations.
2.8.3 Interlocks	Handwheels rotate both in manual or power drive transport modes. This feature allows manual assist for slow speed power transport. No interlocks are necessary, however, normal caution should be exercised when using the power transport because of the rotating spindle handwheels.
2.8.4 Table Stability	With the table in the maximum tilt position along the long axis, the center of gravity is along a line approximately 3 3/4 inches from the front edge of the base assembly. The table base has a tilt movement of 555 inch pounds. (A downward force of 111 pounds on the leading edge of the table raises the base off its support.) With the table at maximum tilt along the short axis, the center of gravity is along a line approximately 2 11/16 inches from the front edge of the base assembly.

TEST ITEM	TEST RESULTS
2.8.4 Table Stability (Cont'd)	(1 3/16 inches from support table edge when base has minimum overhang.) The table base has a tilt moment of 288 inch pounds. (A downward force of 29 pounds on the leading edge of the table raises the base off its support.) All measurements were made with a 500 foot roll of 9 1/2 inch film on the table.
2.9 OTHER REQUIREMENTS	
2.9.1 Operating Temperature	Tests were conducted on the table for an eight hour period (ambient temperature 75°-77°F). The center area of the viewing glass surface reached 100°F after 50 minutes, but did not exceed 105.4°F during the test period. The temperature of the top front metal surface increased to 104°F during the same period.
2.9.2 Workmanship	With the exception of electrical leakage, standards of construction were good.
2.9.3 Reliability	The table was operated for approximately 30 hours without failure of parts or operating mechanisms.
2.9.4 Accessibility of Components for Maintenance	All parts are easily accessible for maintaining and repairing the table.
2.9.5 Manuals	A one page, printed both sides, operational instruction sheet provided with the table gave ample information. A maintenance manual was not provided.
2.9.6 Engineering Drawings	Not applicable. None provided.

3. CONCLUSIONS

3.1 The light table is simple in mechanical and electrical design providing for easy loading of film and a simple to use, smooth operating film transport system.

3.2 The light table is less complex in mechanical and electronic design but less compact and slightly heavier than the [redacted] 25X1
Advanced 918 Light Table.

3.3 The manual tilt mechanism allows easy tilting of the viewing surface along its short or long axis.

3.4 Table illumination is not uniform. Average intensity level of 2000 foot lamberts meets design guides and appears ample.

3.5 The film tensioning system is good for manual drive, power drive, and manual assist power drive modes of operation.

3.6 The transport system is excellent for slow and fast scanning of film and for rapid or slow rewinding of film in both directions.

3.7 The maximum 105.4 operating temperature of the viewing glass surface was not objectionable from the standpoint of causing film damage or operator discomfort.

3.8 The operational noise level generated by the table is low.

3.9 A more compact design along the table's long dimension is desirable for using the table in the short axis tilt mode of operation. For other modes of operation, the table size is not objectionable.

3.10 The following modifications would improve the engineering de-
25X1 sign of the [redacted] Table.

3.10.1 A more even distribution of illumination.

3.10.2 Provide a detented null position on the transport knob.

3.10.3 Reduce the size of spindle springs to provide easier removal of film spools.

3.10.4 Increase slightly the maximum bracket adjustment to facilitate easier removal of $9\frac{1}{2}$ inch spools.

3.10.5 Reduce the overall long dimension of the table.

3.10.6 Reduce weight where possible.

3.10.7 Provide handles or lift bars for transporting the table.

3.10.8 Reposition the power transport control (motor control) and dimmer knob to provide best position for all modes of operation.

3.10.9 Provide small tolerance parallel (skew) and longitudinal alignment and/or adjustments for bracket assemblies to give better film tracking.

4. RECOMMENDATIONS

4.1 It is recommended that the [redacted] Model B High Intensity Light Table be given due and further consideration for future use at NPIC. Its design, now quite good, can be improved by making the design modifications listed in Section 3.10. 25X1

4.2 The manufacturer should be given a copy of those portions of the report which make no mention to NPIC or [redacted] which makes this report unclassified. 25X1

4.3 It is recommended that the information content of this report with regard to achieved engineering results be utilized for determining design requirements/goals, for future light table development and/or procurement.

DISTRIBUTION

1 - NPIC/TSSG/PPS
1 - NPIC/TSSG/DED/Ch
1 - NPIC/TSSG/DED [redacted] 25X1
1 - NPIC/IEG [redacted] 25X1
1 - DDI/IAS [redacted]
1 - DIAAP-9 [redacted]
1 - Army/SPAD [redacted]
1 - TSSG/ESD/TEB file
2 - TSSG/ESD